QUESTIONSHEET 1

Law 1: ref to chromosomes in homologous pairs;
only one of the pair passes into a gamete during meiosis;
the alleles of a contrasting pair are situated on different but homologous chromosomes;
thus only one allele of the pair can go to a gamete (dependent mark); **4**

Law 2: chromosomes/chromatids assort independently during meiosis;
one chromosome/chromatid of the pair goes to one pole and the other to the other pole but which goes either way is random;
the two genes (allelic pairs) occupy different homologous chromosomes;
thus it is purely random which of the alleles of one gene becomes combined with which of the alleles of the other gene;(dependent mark) **4**

TOTAL 8

QUESTIONSHEET 2

(a) (i) 6; **1**

(ii) 18 (it is triploid); **1**

(iii) XXY/XXX (formed from 2 female nuclei and one male nucleus); **1**

(b) (i) $\frac{66}{2} + \frac{60}{2} = 63$; **2**

(ii) 31; **1**

(iii) chromosomes of horse and donkey are different shapes and numbers;
thus exact pairing/synapsis to form bivalents cannot occur;
meiosis/gamete production fails; **2**

TOTAL 8

QUESTIONSHEET 3

(a) (i) P bb brown and white x Bb black;
G ⓑ ↓ Ⓑ ⓑ;
F_1 bb brown and white + Bb black; **3**

(ii) BB Bb | bb;
black | brown and white;
3 | 1; **3**

(b) test cross black moths with the double recessive/brown and white moths;
if all offspring black then test parent is probably BB/homozygous;
if some offspring brown and white then test parent is Bb/heterozygous;
relevant complete genetic diagrams to show this;
comment on necessity to hatch eggs, rear larvae and pupae to adult before crosses can be performed; **5**

TOTAL 11

QUESTIONSHEET 4

(a) (i) recessive;
because obvious heterozygotes/carriers don't show the condition/the alletes in 6/8/13 must have come from the parents who do not show the condition; **2**

(ii) 1 + 2; 3 + 4; 10 + 11; (lose 1 mark for each incorrect) **3**

(iii) $^2/_3$ rds; **1**

(b) sickle cell anaemia;
phenylketonuria/albinoism/any other valid defect; **2**

TOTAL 8

QUESTIONSHEET 5

(a) the specific position of the alleles on the (specific) homologous chromosomes; **1**

(b) (i) when a gene has more than two alleles;
thus more variations of the character can be shown;
such as the four blood groups A, B, AB and O/credit any relevent examples; **3**

(ii) when two alleles both exhibit an effect in the phenotype;
correct example/shown in group AB where allele A causes antigen A to be formed and allele B causes antigen B to be formed; **2**

(iii) only shown in the homozygote/ in the absence of a dominant allele;
correct example/the recessive O allele can only exert its effect to cause group O in the double recessive/OO condition; **2**

(c) P AO x BO (no mark)
gametes Ⓐ Ⓞ Ⓑ Ⓞ;
↓
F_1 AO BO AB OO;
group A B AB O; **3**

TOTAL 11

QUESTIONSHEET 6

(a) a length of DNA which contains the genetic code to enable the synthesis of a specific polypeptide;
situated at a specific locus/position on a specific chromosome;
consists of two or more variants called alleles; **3**

(b) (i) the actual genes/alleles an individual organism/species possesses; **1**

(ii) the actual appearance of the individual/species which is a result of the effects of the genotype and the environment; **1**

(iii) where an organism receives different alleles for the gene from each parent; **1**

(c) (i) P DD x Dd (no mark)
gametes Ⓓ Ⓓ ⓓ;
↓
F1 DD Dd ;
Kerry Dexter ; **3**

(ii) P Dd x Dd (no mark)
gametes Ⓓ ⓓ Ⓓ ⓓ;
↓
Fl DD Dd Dd dd ;
Kerry Dexter Bulldog ; **3**

(iii) Kerry x Dexter;
other cross produces bulldog calves which is uneconomical; **2**

TOTAL 14

QUESTIONSHEET 7

(a) (i) P BbEe x BbEe ;
Gametes (BE)(Be) (BE)(Be)
(bE)(be) (bE)(be) ; **2**

F_1	BE	Be	bE	be
BE	BBEE black erect	BBEe black erect	BbEE black erect	BbEe black erect
Be	BBEe black erect	BBee black flop	BbEe black erect	Bbee black flop
bE	BbEE black erect	BbEe black erect	bbEE red erect	bbEe red erect
be	BbEe black erect	Bbee black flop	bbEE red erect	bbee red erect

3 marks for correct punnet square with phenotypes associated with genotypes;;;
(1 mark penalty for each error/omission)

Ratio - 9 black erect : 3 black flop : 3 red erect : 1 red flop; **4**

(ii) either colour allele can be associated with either ear allele;
Mendel's second law states that either of a pair of contrasting characters can be combined with either of another pair; **2**

(b) P BbEe x bbee (no mark)
gametes (BE) (be) (be);
F_1 BbEe bbee ;
black erect red flop ;
50 % 50% ;

Accept answers that show a <u>small stated</u> proportion of recombinants

gametes Be and bE are unlikely to form since B is next to E and b next to e on the same chromosome pair;
could only form if chiasmata/crossovers occur and separate the gene loci; **6**

TOTAL 14

QUESTIONSHEET 8

(a) (i) BBEE, BBEe, BbEE, BbEe;
(ii) bbEE. bbEe;
(iii) BBee, Bbee, bbee; (all genotypes required for the marks) **3**

(b) an epistatic gene is one that influences the expression of another gene ;
randomly assorting means that the gene is on a different homologous pair of chromosomes to the gene it is influencing ;
thus segregates independently in meiosis/not linked/behaves in a Mendelian manner ; **3**

(c) P bbEe x BbEe (no mark)
gametes (bE)(be) (BE) (Be) (bE) (be) ;

F_1

	BE	Be	bE	be
bE	BbEE black	BbEe black	bbEE cream	bbEe cream
be	BbEe black	Bbee albino	bbEe cream	bbee albino

2 marks for punnet square with correct phenotypes linked to genotypes;;
(1 mark penalty for each error/omission)
Ratio - 3 black : 3 cream : 2 albino; **4**

TOTAL 10

QUESTIONSHEET 9

(a) never breed from blind dogs (except in a test cross);
test cross normal dogs with blind dogs;
check puppies at 10 weeks for signs of disease;
if disease shows then normal parent is heterozygous/Rr;
thus must not be used for breeding;
if the litter contains at least six normal pups and no abnormal assume the normal parent is homozygous/RR;
if the litter only contains two or three normal dogs then must repeat the testcross since normal heterozygote may not have passed on the recessive gene; **max 6**

(b) no ;
the normal gene will continue to mutate into the disease causing gene; **2**

TOTAL 8

QUESTIONSHEET 10

(a) (i) l. X^DY;
2. X^DX^d ;
3. X^DX^D or X^DX^d;
4. X^dY ;
5. X^dY ;
6. X^DX^d ;
7. X^DY ;
8. X^DX^D or X^DX^d ;
9. X^dY ;
10. X^dY ; **10**

(ii) Duchenne allele is on the X chromosome in the part which does not have a corresponding allele on the Y chromosome;
in females is masked by the dominant allele on the homologous locus so such individuals act as carriers;
not covered in male so they manifest the recessive gene if they receive it;
1 in 4 chance of having an affected male child if mother is a carrier;
mother has a 1 in 2 chance of being a carrier; [max 2 if just shown as a cross with ratios] **max 4**

(b) l. haemophilia;
2. red green colour blindness; **2**

TOTAL 16

QUESTIONSHEET 11

a)

Cross	Possible alleles available		Impossible phenotypes in offspring
	parent 1	parent 2	
A x B	A, O	B, 0	none ;
A x AB	A, O	A, B	O ;
A x O	A, O	O	B, AB ;
B x B	B, O	B, O	A, AB ;
B x AB	B, O	A, B	O ;
B x O	B, O	O	A, AB ;
AB x AB	A, B	A, B	O ;
AB x O	A, B	O	AB , O ;
O x O	O	O	A, B, AB ;

9

(b) since lst child has group O both parents must possess the O allele ;
since second child has group AB one parent must have A allele and the other the B allele ;
thus could give rise to a group B child of genotype BO ;
thus the man's claim is not justified on this evidence ; **4**

TOTAL 13

QUESTIONSHEET 12

(a) (i) peas – discontinuous;
humans – continuous; **2**

(ii) peas -
stature in peas is regulated by one gene which has only two alleles ;
the dominant allele causes tall plants to be produced and the recessive allele causes short plants to be produced;
thus shortness can only be shown in the double recessive state;
breeding by heterozygotes would produce the monohybrid ratio of 75 % tall to 25 % short;
there is no overlap in the expression of the two alleles;
thus two populations develop in relation to stature; **max 5**

humans -
stature in humans is regulated by several genes/ref polygenic;
each of these genes may have many alleles/multiple alleles;
no clear dominant or recessive alleles;
each particular allelic variant (of the gene) may exert a slightly different effect in the phenotype;
thus heterozygotes could contain any two alleles for the gene out of possible hundreds;
this would give a wide variation/ continuous variation of phenotypes; **max 5**

(b) select individuals of: same age ;
same sex ;
same state of health/nutrition/race; **3**

TOTAL 15

QUESTIONSHEET 13

(a) (i) codominance; **1**

(ii) P cream x chestnut
C^CC^C C^HC^H ;
gametes C^C C^H;
F_1 $C^C C^H$;
(palomino) **3**

(iii) palomino 50%, cream 25%, chestnut 25% ; **1**

P palomino x palomino
$C\ ^CC^H$ C^CC^H
gametes C^C C^H C^C C^H;
F_1 C^CC^C C^CC^H C^CC^H C^HC^H ;
cream palomino chestnut
25% 50% 25% ; **3**

(b) never breed two Manx cats together, only cross Manx with tailed cats; 1

P Manx x Manx Manx x Tailed
Mm Mm; Mm mm;
gametes M m M m ; M m m ;
F_1 MM 2Mm mm Mm mm
stillborn ; no stillborn ; **6**

TOTAL 15